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U.S. Department of Energy

UChicago ▶ Argonne LLC

Office of Science U.S. DEPARTMENT OF ENERGY

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Dark Energy Survey Activities

Steve Kuhlmann

DES group members: Joe Bernstein, Kyler Kuehn, SK, Hal Spinka, Rich Talaga

Mechanical group: Vic Guarino, Tom Kasprzyk, Frank Skrzecz, Allen Zhao, + Bld. 366 support team

Additional: Eve Kovacs, John Cunningham (Loyola), Ian Crane (UIUC), Savannah Insalaco (UIUC), Tara Hufford (Loyola), Dallas Turner (Rockford Schools)

Also: Rahul Biswas (UIUC) (post-doc starting next month), Kohki Konishi (applying for Director's Post-doc Fellowship)

Outline

- Building/Commissioning DECam
- PreCam (e.g., “mini-DECam”)
- Specialized studies of DECam CCDs
- Supernova Science
- Supercomputing (Cosmology and Supernovae)
- DES Cluster Science and the South Pole Telescope

DARK ENERGY
SURVEY

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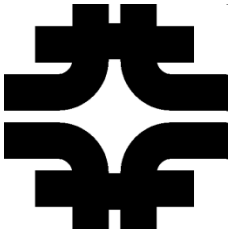
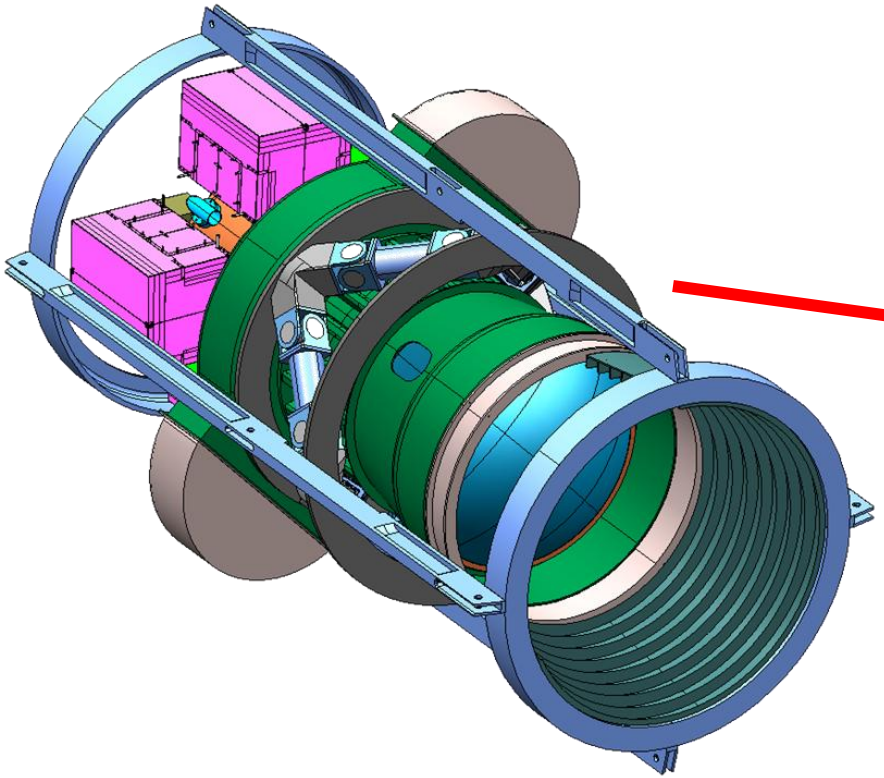
Office of Science
U.S. Department of Energy



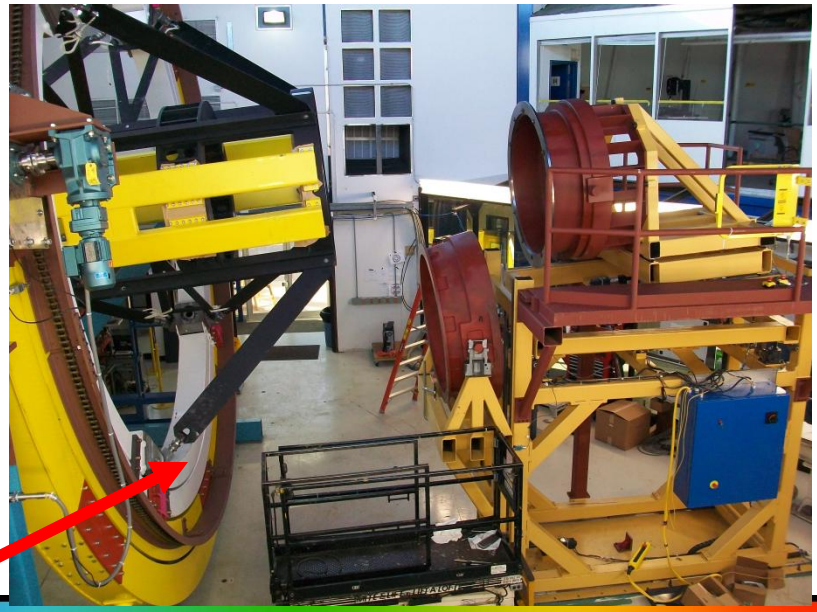
Dark Energy Camera (DECam), many roles for ANL



- CCD analysis of Traps (production testing code)
- CCD focal plane thermal analysis
- Instrument Control System – ANL L3 manager
  (Shutter control, Filters, CCD Temps, Vacuum, LN2, …)
- Electronics cooling system – ANL L3 manager
- Filter changer installation mechanism – ANL L3

f/8 Handling System

- Used to install and remove the f/8 secondary mirror from DECam
- Lead Engineer Allen Zhao (ANL) led the design, procurement, assembly and testing at ANL, now leading mating tests with DECam at FNAL.
- Currently being tested at FNAL
- First piece of DECam to go through acceptance testing
- Will go through hand-off and shipping process to CTIO this summer



White rings also engineered at ANL

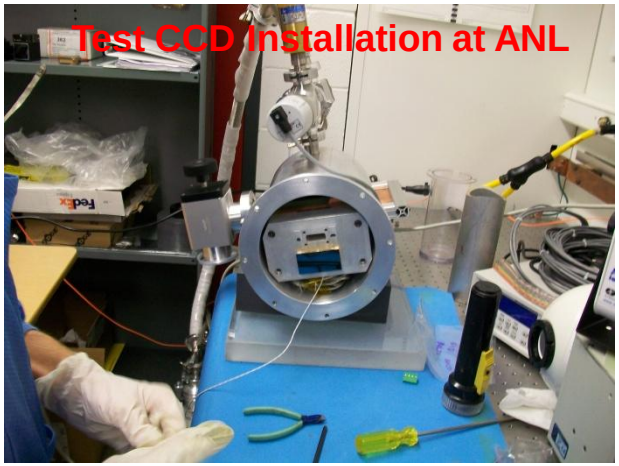
Mosaic Image Using Prototype DECam Imager
(currently using poor-grade CCDs)

PreCam: a "mini-DECam," led by Kyler Kuehn ANL post-doc

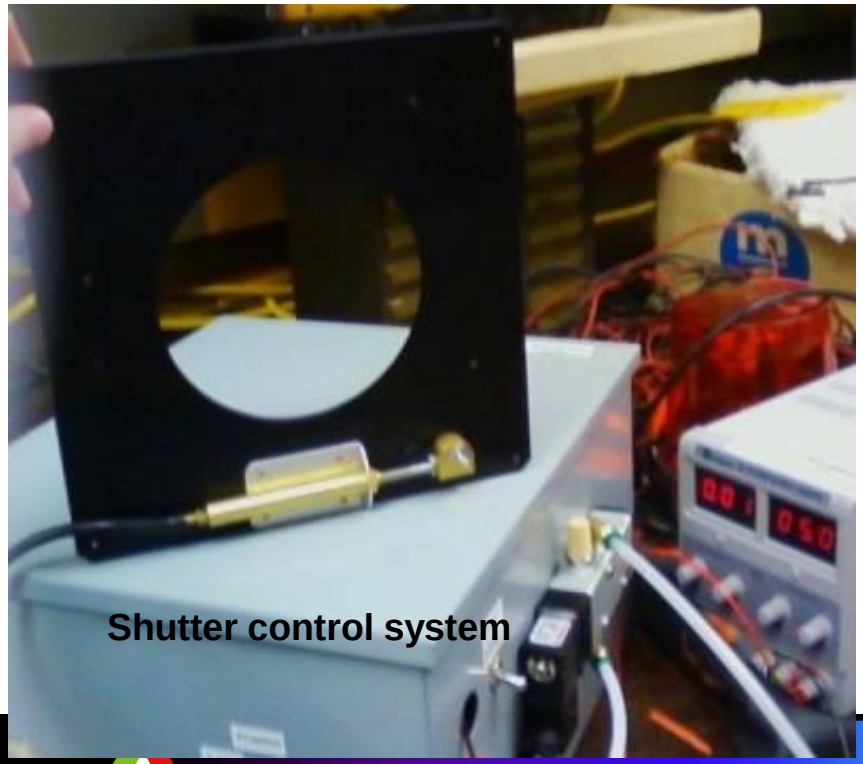
- Science motivation for pre-survey observations with DECam hardware
  - 0.01 calibrated stars/image w/o PreCam:
  - ~1000/image with SNR>50 with PreCam
  - reach 2% photometry requirement faster (1 yr vs 2yr?)
  - better chance to reach 1% photometry goal
  - possible 10% savings (~$1M!) in telescope time
  - calibration is currently largest SN dark energy uncertainty
- Test-bed for DECam hardware, software, and observing strategies
- Schedule is for August 11th mechanical test at CTIO, first light Aug 18
- PreCam components being tested now in HEP
  - pressure vessel, vacuum system, cryo-cooler
  - shutter control system: same as DECam
  - temperature control system: can regulate the CCD & vessel to 0.25K
  - electronics readout crate and DAQ software: same as DECam
  - DECam CCD

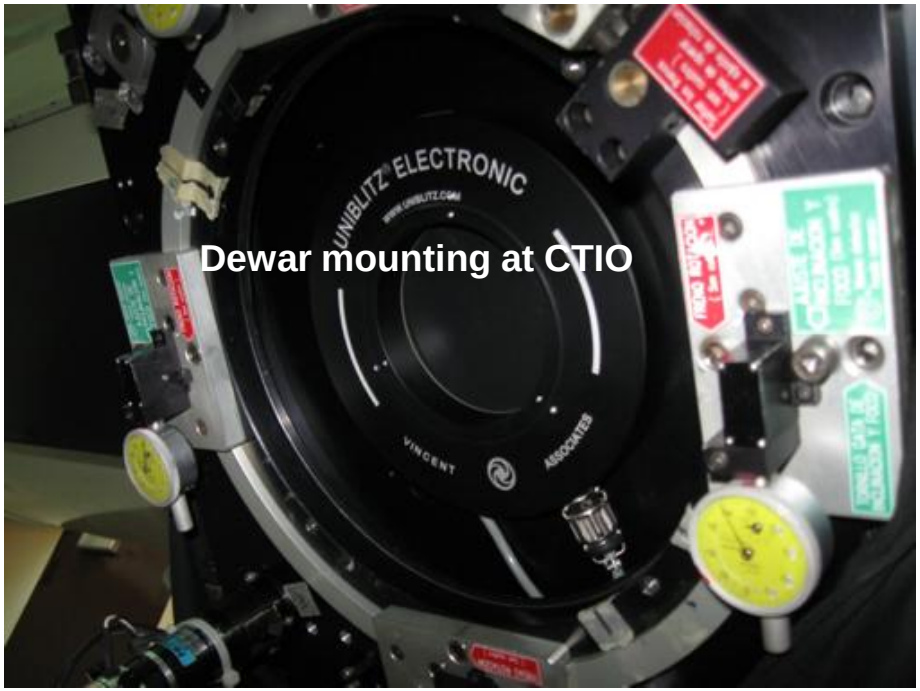
PreCam Hardware


Test CCD Installation at ANL


Test CCD Installation at ANL

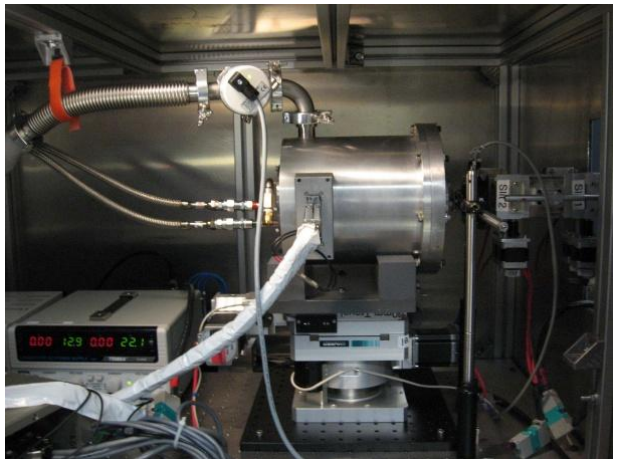

Real CCD Installation at FNAL


Shutter control system

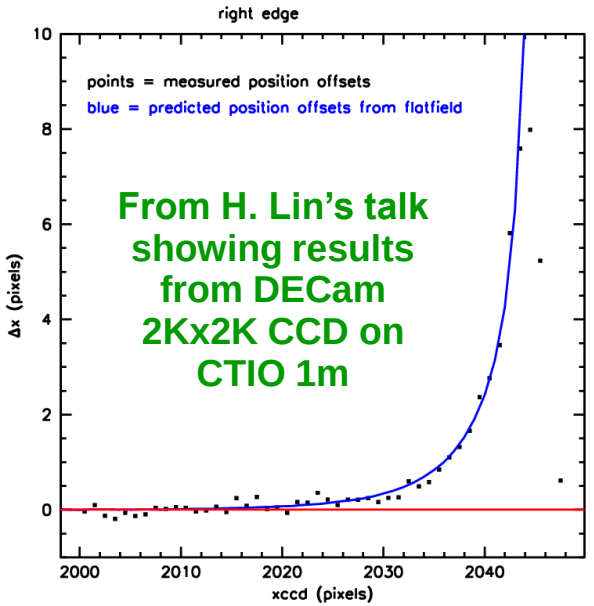


Dewar mounting at CTIO

DECam Charged Coupled Device Studies: X-ray irradiation studies in APS X-ray Lab



Paper Submitted



From H. Lin's talk showing results from DECam 2Kx2K CCD on CTIO 1m

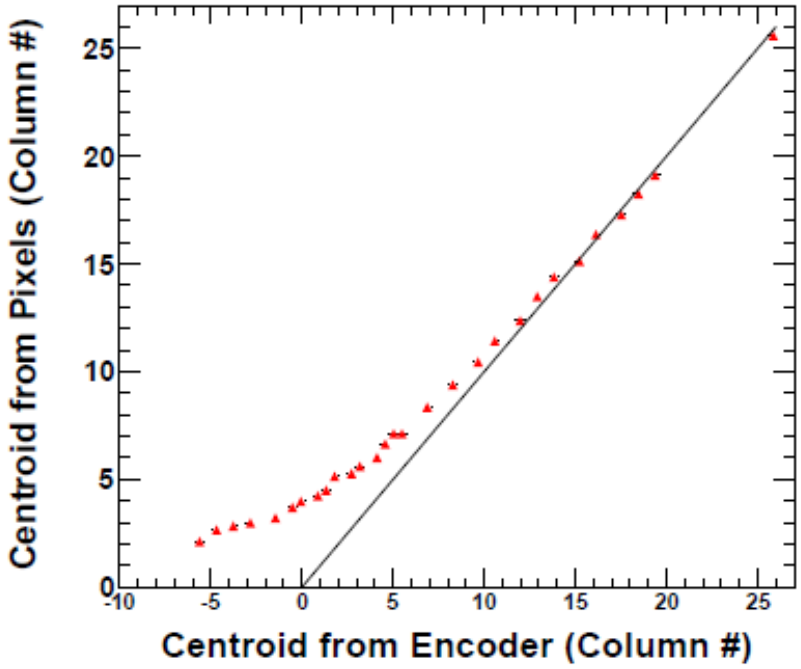
Experimental Astronomy manuscript No.
(will be inserted by the editor)

Narrow-Beam X-Ray Tests of CCD Edge Response

S. Kuhlmann · H. Spinka · J. P. Bernstein · K. A. Beyer · L. M. Gades · T. E. Kasprzyk · A. Miceli · R. A. Spence · R. Talaga

Received: date / Accepted: date

Abstract The physical boundaries of a fully-depleted CCD can lead to distorted field lines and non-uniform response. We study this response with a beam of x-rays constrained to a width of less than one pixel (15 μm), and a system to map the CCD response as a function of transverse position.



ANL SN Refs

Dark Energy Survey Supernovae: Simulations and Survey Strategy

DES

J. P. Bernstein
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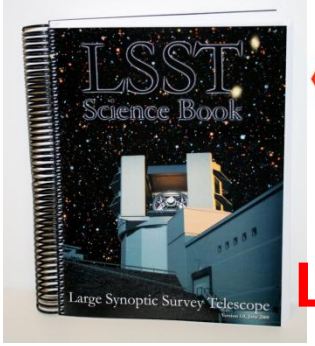
R. Kessler
University of Chicago, KICP, Chicago, IL 60637

S. Kuhlmann and H. Spinka
Argonne National Laboratory, HEP Division, Argonne, IL 60439

For the Dark Energy Survey Collaboration

Cosmology, Proceedings of the 43rd Rencontres de Moriond", Eds. J. Dumarchez, Y. Giraud-Heraud, J. Tran Thanh Van, pp.71-74, 2009, The Gioi Publishers, Vietnam

http://arxiv.org/abs/0906.2955



DARK ENERGY SURVEY

LSST

LSST Science Collaborations and LSST Project 2009, LSST Science Book, Version 2.0, arXiv:0912.0201, http://www.lsst.org/lsst/scibook

SNANA: A PUBLIC SOFTWARE PACKAGE FOR SUPERNOVA ANALYSIS

Richard Kessler,[1,2] Joseph P. Bernstein,[3] David Cinabro,[5] Benjamin Dilday,[4] Joshua A. Frieman,[2,1,6] Saurabh Jha,[4] Stephen Kuhlmann,[3] Gajus Miknaitis,[7,6] Masao Sako,[8] Matt Taylor,[5] Jake VanderPlas[9]

Publications of the Astronomical Society of the Pacific, Volume 121, issue 883, pp.1028-1035 DOI: 10.1086/605984

PHOTOMETRIC ESTIMATES OF REDSHIFTS AND DISTANCE MODULI FOR TYPE IA SUPERNOVAE

Richard Kessler,[1,2] David Cinabro,[3] Bruce Bassett,[11,12] Benjamin Dilday,[4] Joshua A. Frieman,[1,2,5] Peter M. Garnavich,[6] Saurabh Jha,[4] John Marriner,[5] Robert C. Nichol,[7] Masao Sako,[9] Mathew Smith,[11] Joseph P. Bernstein,[8] Dmitry Bizyaev,[13] Ariel Goobar,[14,15] Stephen Kuhlmann,[8] Donald P. Schneider,[10] Maximilian Stritzinger[16,17]

SDSS

Accepted by ApJ

http://arxiv.org/abs/1001.0738

SUPERNOVA PHOTOMETRIC CLASSIFICATION CHALLENGE

Richard Kessler,[1,2] Alex Conley,[3] Saurabh Jha,[4] Stephen Kuhlmann[5]

Challenge Released on Jan 29, 2010. Last update: April 29, 2010

http://arxiv.org/abs/1001.5210

DES

Supernovae Simulations and Strategies: Application to the Dark Energy Survey

(Draft: April 19, 2010)

J. P. Bernstein[1], R. Kessler[2,3], S. Kuhlmann[1], R. Reis[4], I. Crane[1,5], D. A. Finley[4], J. A. Frieman[2,3,4], T. Hufford[1], A. G. Kim[6], J. Marriner[4], P. Mukherjee[7], R. C. Nichol[8], P. Nugent[6], D. R. Parkinson[7], M. Sako[9], H. Spinka[1]. . .

ANL Group positioned to lead DES SN analysis

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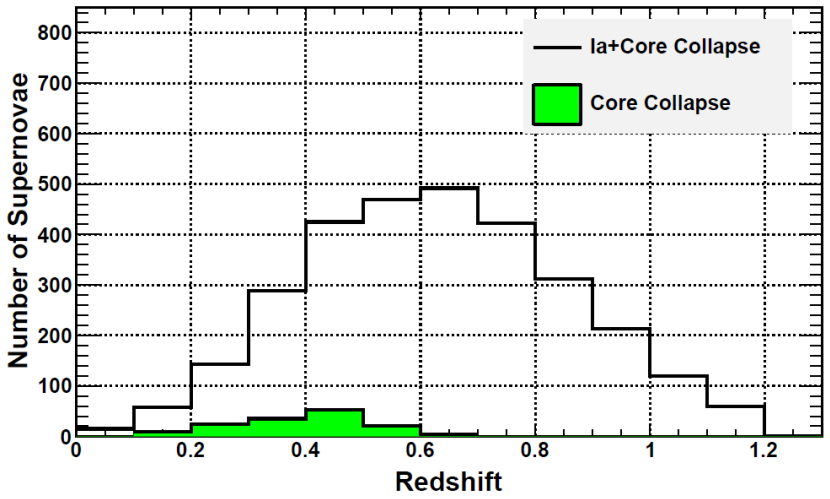
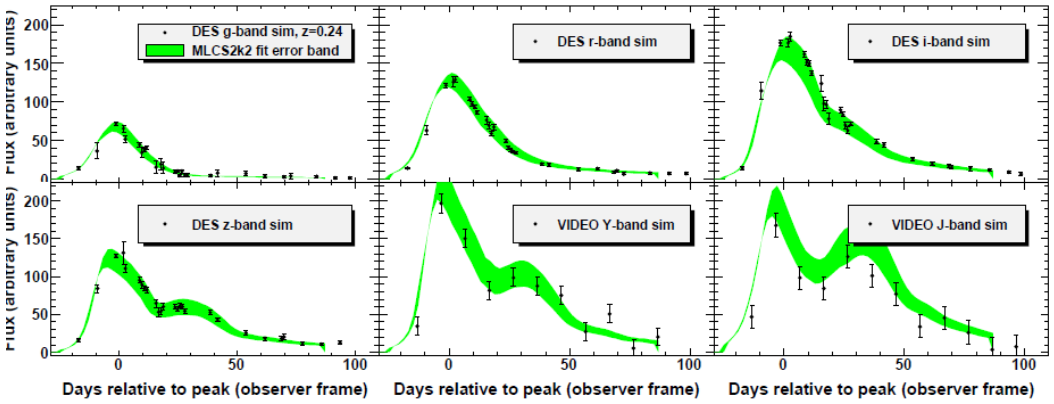
Important aspects of the DES Supernova Survey

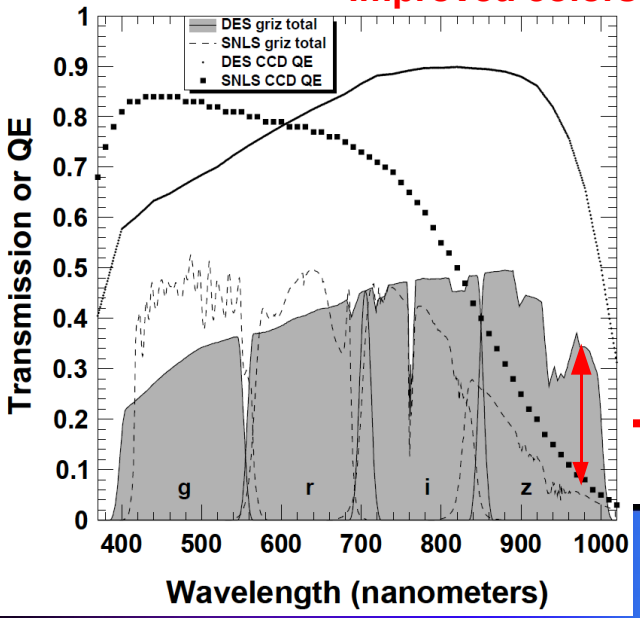
Deep survey (compared to Pan-STARRS)

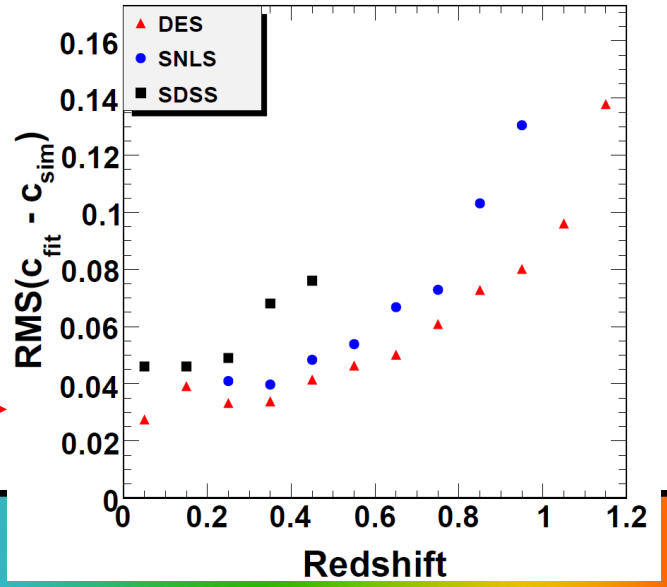


Complementary Infrared information from VIDEO



Improved colors relative to SNLS & SDSS





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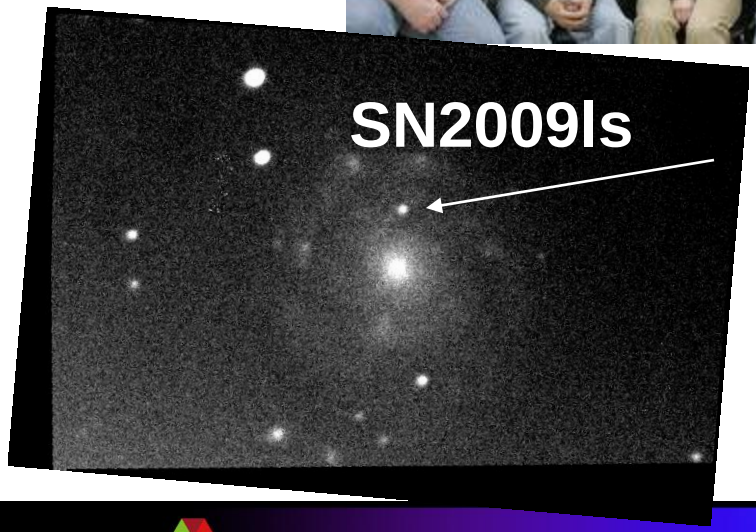
Collaboration with Rockford High Schools on Supernova Studies

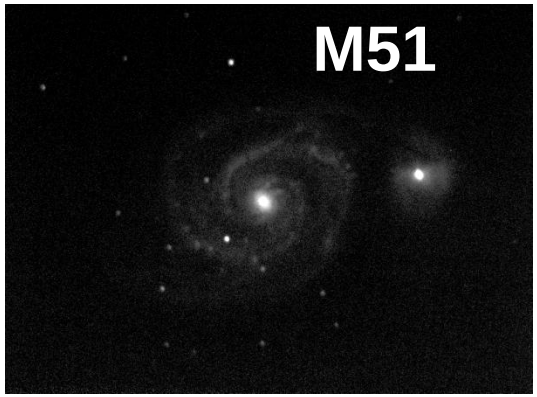
Dallas Turner part of 3-year ACTS program

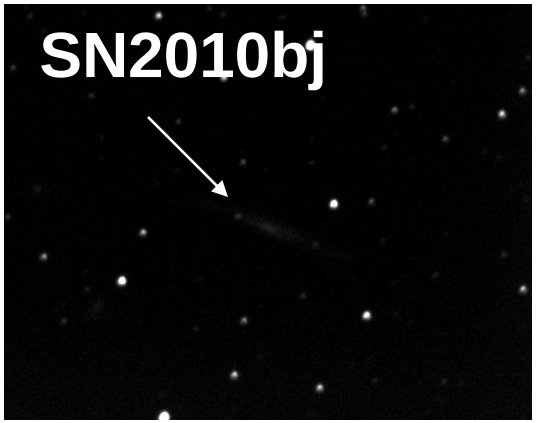
Telescope/CCD bought last year with DES LDRD

First year goal achieved, see SN from Rockford

Second year goal, light curves in 3 filters, analysis with DES Terapix software







Supercomputing at ANL: Cosmology and Supernovae

- ANL Blue Gene/P 160K processors, already used for FLASH SN.
- Previous 1-yr LDRD with UC/FNAL for cosmology.
- SK co-PI on successful joint ANL/UC/FNAL to push SN simulations forward and compare with data.
- J. Bernstein moved into Computational Fellowship Feb 15, working on both FLASH SN and cosmology.
- Offer being prepared for Salman Habib and Katrin Heitmann, leaders in computational cosmology.

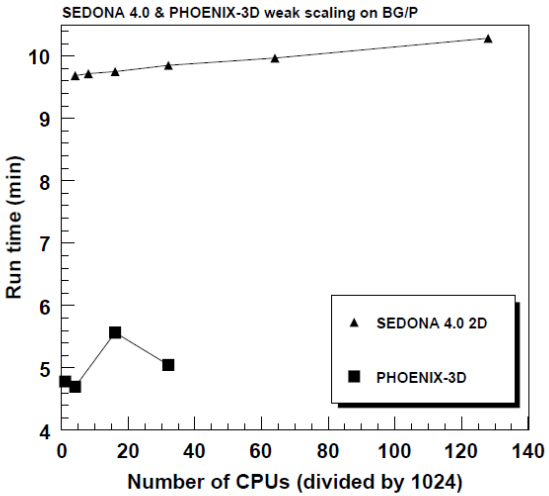
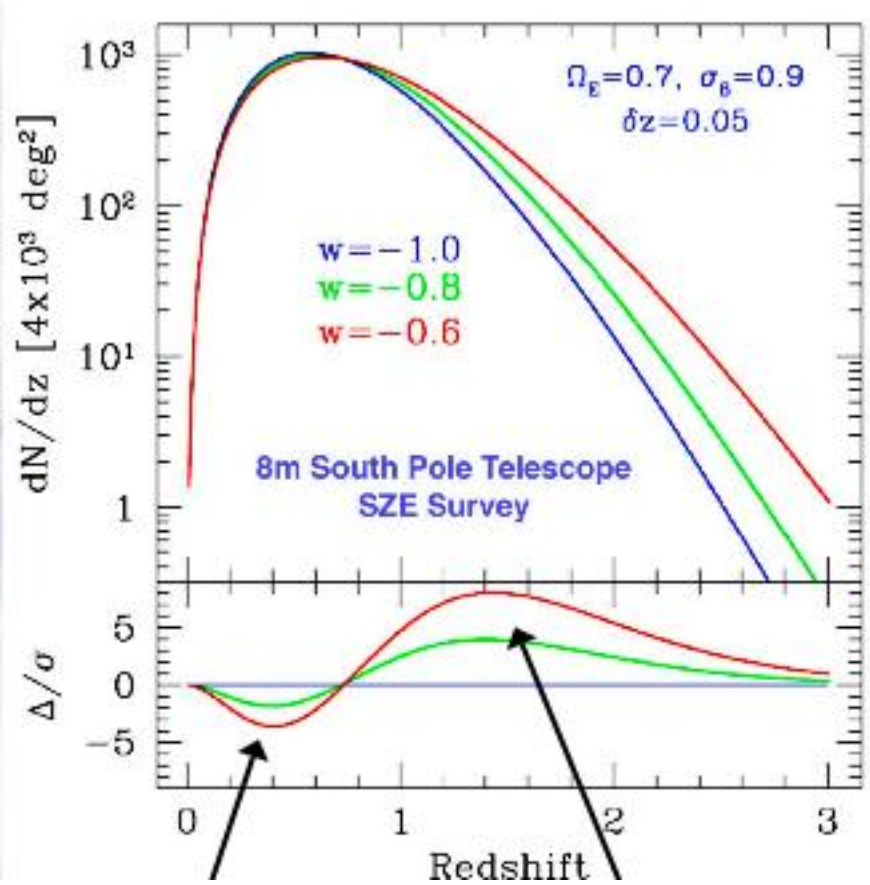


Figure 1: PHOENIX and SEDONA weak scaling on Blue Gene/P.

DES Galaxy Clusters and the South Pole Telescope

- Important part of DES science
- Will help separate dark energy effects from modified gravity.
- Opportunity for ANL/HEP to collaborate with UC and ANL/MSD on DES science and SPT hardware.



Conclusions

Important roles in DECam

Leadership role in DES calibrations/PreCam

DES Supernova Leader

Supercomputing Cosmology and Astrophysics ready to expand

DES Clusters/SPT Excellent Opportunity for ANL/HEP

Backup Slides:

DECam and PreCam Commissioning and Operations

	FY2011	FY2012-2016
DES Operations Support (shifts under research)	$10K	$0K (Real f/8 mirror install in 2012??)
PreCam Operations Support (shifts under research)	$0K	$0K
DES Research	1.5 FTE Staff 1.0 FTE Postdoc $30K M&S	2.0 FTE Staff/year 2.0 Postdoc/year $30K M&S
PreCam Research	0.5 FTE Staff 1.0 FTE Postdoc $6K M&S	?? (Possible will want to take data during DECam operations)